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The Brush Arc Lamp

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Brush

THE BRUSH ELECTRIC CO.,
CLEVELAND, O., U.S.A.

621.32
Brush
Arc

THE

BRUSH ARC LAMP,

MANUFACTURED BY

THE BRUSH ELECTRIC CO.,

Cleveland, Ohio.

U. S. A.

PRESS OF
THE F. W. ROBERTS COMPANY,
CLEVELAND, OHIO.

Introduction.

THE early history of the Brush Arc Lamp would make a most interesting story of pioneer scientific achievement. Absolutely the first in the field, it has successfully withstood the onslaught of fierce competition, and on its merits alone has made for itself an army of friends, who will peruse these pages with kindly interest.

Nearly fifteen years ago, in Cleveland, Ohio, the first practical Arc Lamp, invented and patented by Mr. Chas. F. Brush, shed its rays on an astonished public. Since that event there has grown up a business of enormous proportions. It is estimated that there are three hundred thousand arc lamps burning nightly in America. The first lamp was a Brush, and a very large number of the three hundred thousand are Brush lamps.

With the tremendous growth of the arc lighting industry there has necessarily come competition, which is the mother of improvement in the perfection of apparatus. The manager of a central station, casting his eye over the yearly balance sheet to ascertain why the expected large dividend has not matured, finds the leak in the repair and labor account. This aspect of the case has become more and more significant as the price received for lighting has been gradually reduced.

The Brush Electric Company, therefore, realizing that the lamp considered perfect ten to fifteen, or even five years ago, cannot be called perfect to-day, present herewith a detailed description of their new arc lamp, which they have been perfecting with the greatest care, and under the direction of skilled electricians.

Mr. T. E. Adams has been, for the last twelve years, with the Brush Electric Company handling their apparatus, and a number of years at the head of the Brush Arc Lamp Department. He is probably one of the best posted arc lamp experts in the country, and to him many of the improvements in the new lamp are due. The Brush Electric Company own Mr. Adams' patents.

The best things are acquired by the longest and hardest experience, and it is simply an undisputed fact that there is no other electrical company which has had the same opportunities for learning the requisite points necessary to an arc lamp, perfect in principle and detail.

Therefore, with a reputation acquired by the most conservative business methods, and knowing the meaning of positive statements regarding new devices, the Brush Electric Company do not hesitate to say that the arc lamp explained herein stands alone, and no other make can be compared with it.

General Description.

AN arc lamp has three principal functions to perform :

1. Establish the arc.
2. Regulate the arc.
3. Feed the carbon.

To arrive at the method by which these functions are performed, it will be necessary to go into a somewhat detailed explanation of the lamp's construction.

In the first place there is no spring whatever about it. There are two electrical connections made of coiled wire, to cause a positive and simple contact, but no springs at all. The tension of a spring changes very materially with the temperature, and more so with use. As the adjustment and feeding of an arc lamp is a very delicate matter, the doing away with springs, common in all other makes, is a marked improvement. A coil spring is a good thing, and has its uses, but it is simply a physical impossibility for a spring to do the same thing in identically the same manner, twice in succession.

It has heretofore been considered a very important point to have the rod slip down through the clamp very gradually, or in shop terms, a "sneak feed." This has always been one of the talking points of the old Brush lamp. The new lamp does not release the rod gradually, but allows it to drop suddenly when the clutch reaches the releasing point. The "sneak feed," or gradual downward slipping of the rod through the clutch or clamp is a good theory and works all right when the rod is clean and perfectly true, but experience has demonstrated that the rod in use becomes dirty and sticky. By a peculiar construction of the clamp in the new lamp it is absolutely unnecessary to have a true or clean rod. As will be shown more in detail, this clamp grips the rod tightly, and after lowering it for a certain distance lets go and takes hold again higher up. Therefore, as far as the correct feeding of the lamp is concerned, the rod might be dirty, rough, or even threaded along its entire length. This point obviates the difficulties heretofore encountered arising from wear on the rod.

The electric action which takes place as the carbons approach each other causes the clamp to again lift the rod, having taken hold a little higher up. It has been found, and will be shown later that a sudden feed with the proper mechanism, maintains a much quieter and steadier arc, with closer regulation than is possible with a "sneak feed" lamp.

There is no dash-pot, glycerine, wax or mercury about the new lamp.

The cut-out is mechanical and has no adjustment whatever. It is positive in operation, and cannot get out of order.

Detailed Description.

WITH these general statements, let us go more into the construction of the lamp.

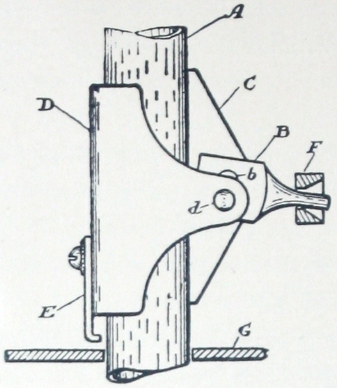


Fig. 1.

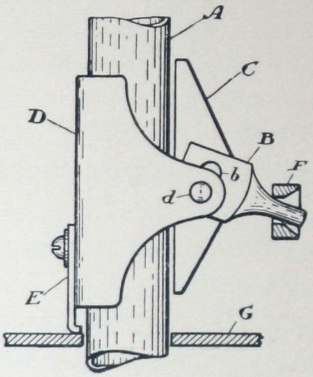


Fig. 2.

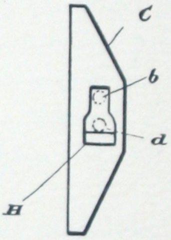


Fig. 3.

Figures 1, 2 and 3 are diagrams of

The Clutch.

THE clutch is the most important device in an arc lamp. These diagrams show a clutch which is the result of fifteen years constant use of and experimenting with all kinds of lamp clutches. Its simplicity and reliability cannot be surpassed.

The same letters relate to the same parts in the different figures :

A. Represents the lamp rod.

B. Represents the clutch lever.

C. Represents the clutch shoe.

D. Represents the clutch saddle.

E. Represents the clutch trip.

F. Represents an arm of the armature (which is moved up and down according to the strength of the spool magnets.)

G. Represents the lamp bottom plate.

H. Represents a slotted rivet hole through *C.*

b. and *d.* Represent rivets.

Figure 1 shows the clutch gripping the rod tightly. The armature arm *F* may move up and down and will carry the rod with it until the clutch trip *E* comes in contact with the bottom plate *G.* As soon as this occurs, however, the downward movement of *D* is arrested, while *F* continues to descend, carrying with it *B.*

H is a slotted hole in *C* made wider at the bottom than at the top. *b* is a rivet which runs through *B* and *C* at the top or narrow part of *H.* *d* is a rivet which runs through *D,* B and *C* at the lower or wide part of *H.* At this point in *H* there is a lateral play of 1-16 of an inch. Now when *E* strikes *G* so as to hold *D* stationary, *F* continues downward and swings *C* outward away from the rod *A* just so far as there is lateral play at its pivot *d,* which is 1-16 of an inch. This allows the rod *A* to descend by its own gravity, thus causing the carbons to approach each other. As will hereafter be clearly shown, the near approach of the positive and negative carbons by decreasing the electrical resistance renews the strength of the spool magnets, and instantly *F* is drawn upwards, which causes *C* to renew its hold on *A,* but at a point a little higher up. This operation is then renewed and continues until the carbons are consumed.

Prejudiced experts might attempt to pick flaws with this clutch and probably offer the objection that the slot *H* will clog with dust and dirt, and render its action useless. This would be the case if the slot was the same size all the way down, but the play provided at that point by widening the slot entirely obviates any possibility of this trouble occurring. It cannot clog up or get out of order. *C* has such a long bearing on *A* that although *A* may be enlarged in diameter by dirt and dust or lessened in diameter by dents there will be enough points at which it will strike the rod that its action will always be quick and positive. This is a great advantage over any lamp which employs a clutch having a small gripping surface.

The Cut=Out.

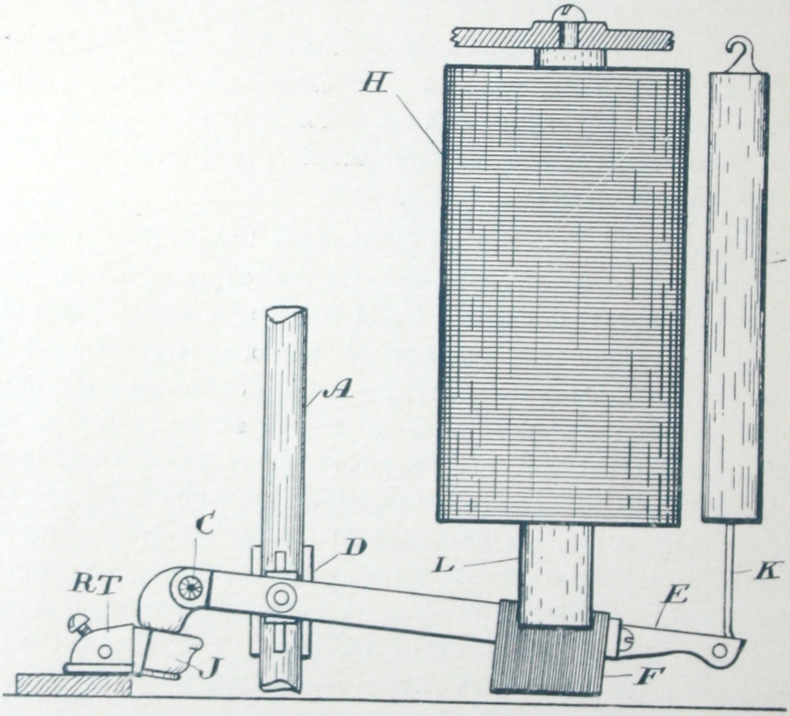


Fig. 4.

THE accompanying diagrams, Figures 4, 5 and 6, show the cut-out and its mechanical position in the lamp:

A. Represents the lamp rod.
C. Represents the pivot of *E.*
D. Represents the clutch.
E. Represents the armature lever.
F. Represents the armature.
G. Represents the air pot.
H. Represents the main magnets.
R. T. Represent the cut-out posts.
J. Represents the cut-out bar.
K. Represents the air pot piston rod.
L. Represents the main magnet core.

Most of these lettered parts will explain themselves. Figure 4 shows the lamp in repose, or at a time when it is not burning. The armature F

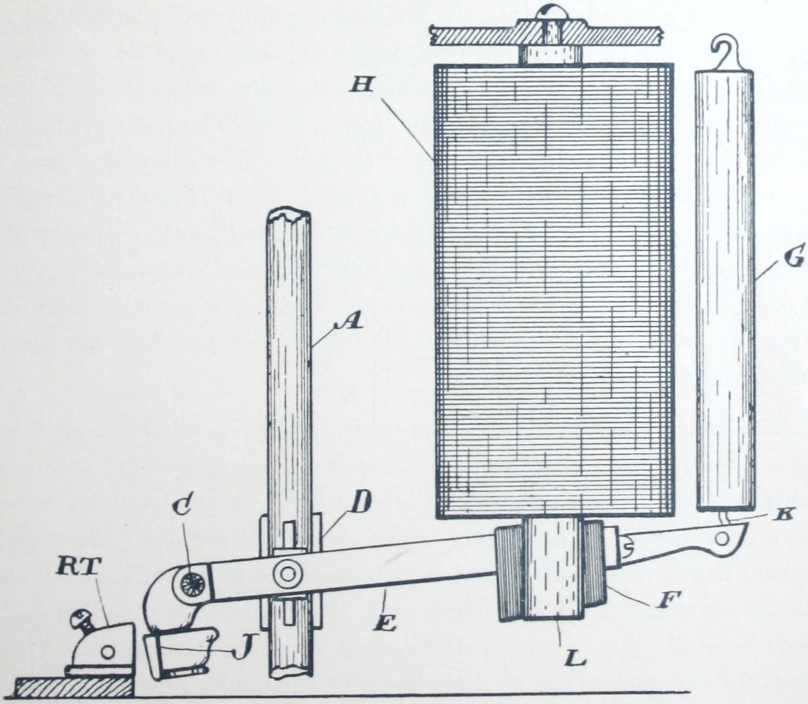


Fig. 5.

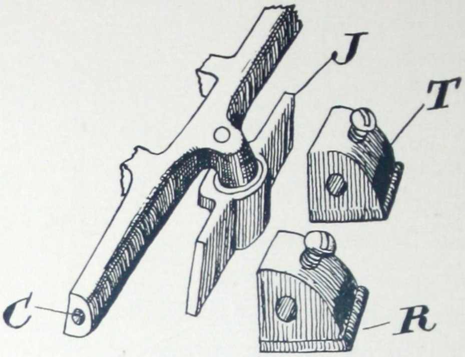


Fig. 6.

falls by its own weight until *J*, which is double faced and on a swivel, as shown in Figure 6, comes flush against *R. T.* By electrical connections, which will be shown, this cuts out the lamp regardless of whether the carbons are together or not. Any lamp which depends upon the carbons for cutting out the lamp is faulty in construction. The trimmer might forget to trim the lamp: the consumer might forget to switch off his lamp, and a number of things might occur whereby (especially in a single lamp) the carbons would be too short to come together. What is needed, therefore, is a positive mechanical cut-out, a device which will allow the current to pass through the lamp with the least possible loss. No one will pay for the use of a lamp when it was not burning, and, therefore, no unnecessary energy should be wasted by causing the current to pass through complicated devices of high resistances.

This cut-out is radically different from that of any other make. Every time a central station manager orders a new cut-out spool from the manufacturer he acknowledges that he is using a lamp which contains a cut-out which does not do what it was made for. This cut-out always works. Measure the distance from the pivot *C* to each end of *E*; notice how long *E* is to the heavy end *F* as compared with the distance to the other end *J*. The faces of *R T* and *J* come together on a perpendicular plane. This is to prevent any dust or dirt settling there which might prevent a positive electrical connection. *F* being heavy, and at the end of the long leverage, will, when allowed to descend of its own weight, push *J* very hard against *R T*. There it will remain and carry ten amperes until the lamp rots, or until *H* is energized by the passage of the current through it, thereby lifting *F* as shown in figure 5. The Brush Electric Company placed one of these cut-outs on a circuit in the middle of their factory in 1884. It remained there, carrying ten amperes all the while, without being disturbed and without causing the least trouble, until 1891, when it was removed on account of rebuilding.

G is not a dash or glycerine pot. It is simply a small brass cylinder, in which works a close-fitting piston attached to *K*. When *E* rises slowly *G* performs no function whatever, as there is a slight escape of air from the air chamber downward past the piston. But when from any cause *E* is *suddenly* raised, then the compressed air in *G* acts as a cushion to prevent noise. It will be observed that no appreciable volume of air can be compressed in *G* until *E* has almost completed its upward stroke; thus, at the commencement of the upward movement, when *J* is drawing away from *R T*, the movement is not affected by *G*. Therefore, the air pot cannot in any manner retard or have any effect on the cut-out or quick action of the clutch.

The connection of the clutch *B* to lever *E* is also shown in Figures 4 and 5. It will be easily seen how the raising and lowering of *F* by electrical action raises and lowers the carbon rod *A*, *D* being attached to *E* at the proper distance from *C*.

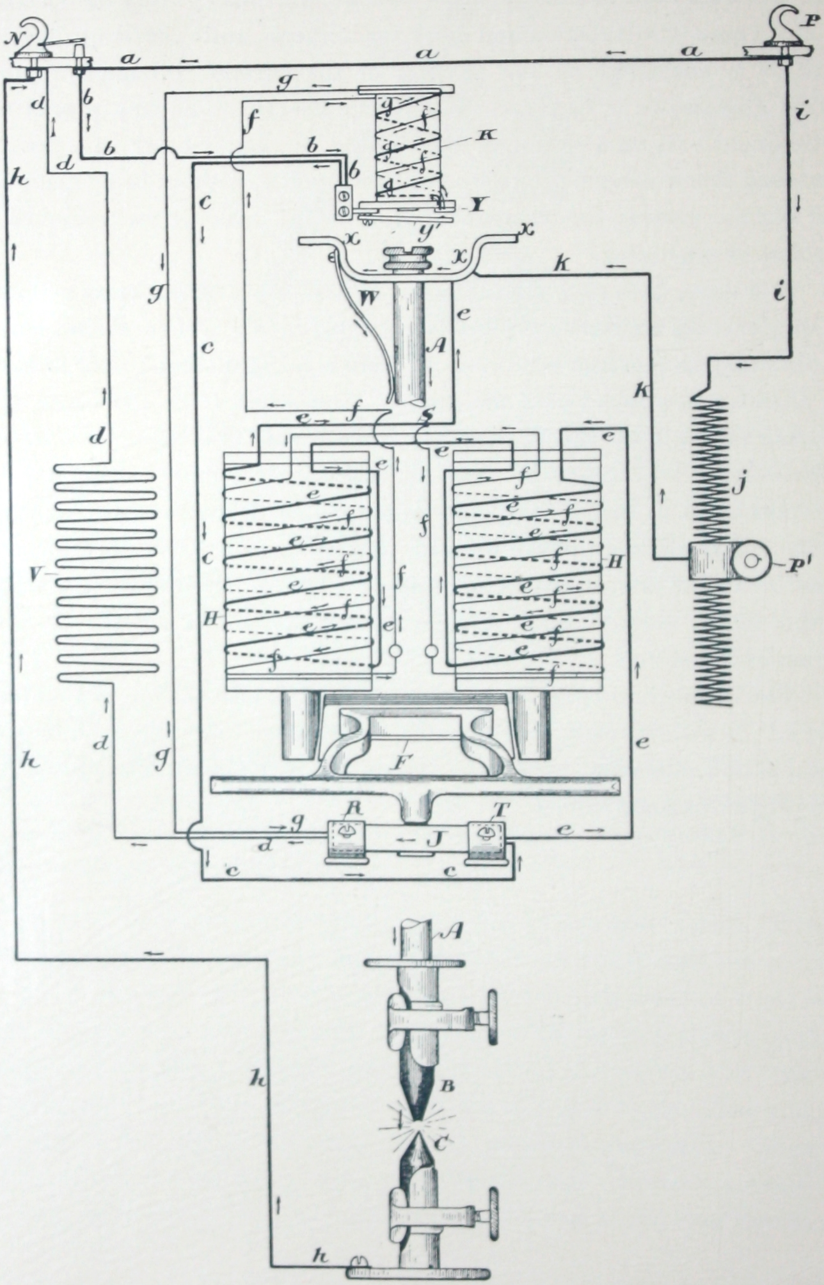


Fig. 7.

Detailed Electrical Connections.

Figure 7 is a diagram of all the electrical connections of the lamp. By a little careful study the various paths of the current through the lamp, with their several meanings, may be mastered.

a. Represents the entering wire.
b. Represents the cut-out connector wire.
c. Represents wire to cut-out post *T*.
d. Represents wire from cut-out post *R* to negative terminal *N*.
e. Represents wire from cut-out post *T* to *X*.
f. Represents wire from point *S* on *e* to *Y*.
g. Represents wire from *Y* to cut-out post *R*.
h. Represents wire from lower carbon to negative terminal *N*.
i. Represents wire from positive terminal to *J*.
k. Represents wire from P^1 to *X*.

Let us now trace the various possible paths for the current. Entering at the positive terminal *P*, it passes along *a*, then *b*, then *c*, to the cut out post *T*. Entering the cut-out post *T* it will take one of two paths, according as to whether the cut-out is closed or not. Assuming that it is closed, the current will pass into the cut-out bar *J*; and then into the other cut-out post *R*. From this post it will follow *d* through the German silver resistance *V* (which is only slight) to negative terminal *N*.

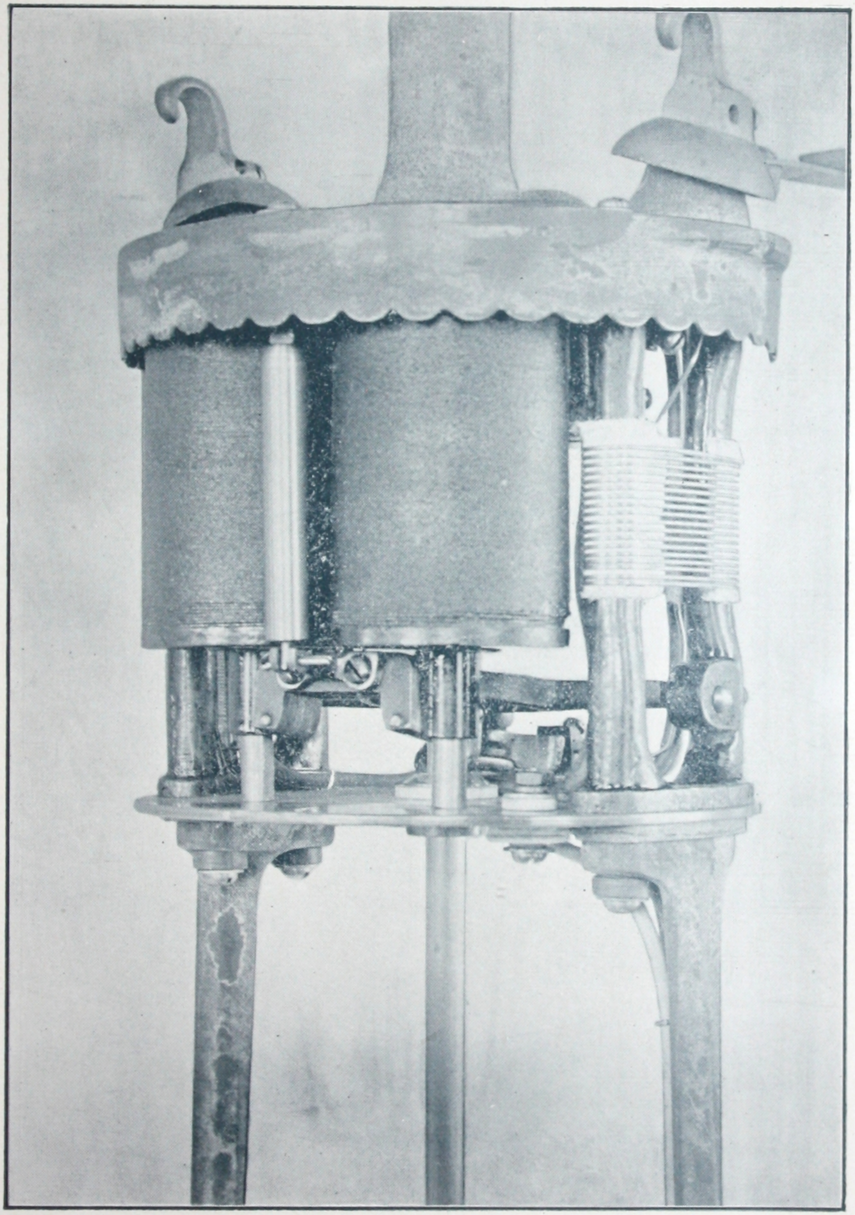
From cut-out post *T* there are two paths, one just described, the other *e*. As each of a number of paths from any given source of electricity will always receive a current strength proportional to its resistance, *e* will get a little of the current when the current is first switched on lamp. If *V* was not in the circuit *d*, not enough current would pass through *e* to accomplish what is desired. Therefore the function of *V* is to force a sufficient portion of the current through *e*. It will at once be seen that the object of this is to energize the magnets *H H* for the purpose of raising the laminated armature *F*. As soon as *F* starts on its upward movement it performs two important acts in succession. First, the cut-out bar *J* draws away from the cut-out posts *T R*; second, the clutch (not shown in Figure 7) takes a grip on rod *A* and lifts it, which, of course, separates the carbons. This very important operation, if followed closely, will show us how the arc is established.

When the cut-out bar draws away from the cut-out post it forces *all* of the current through the path *a*, *b*, *c*, *e*, *X*, *W*, *A*, *B*, *C*, *h*, to negative terminal *N*. With armature *F* down and *J* flush against *R T*, the carbon points are together. They are still together when *J* draws away from *R T*, forcing all of the current through *e* and through the carbon points by the path just described. There is no light as yet, because the carbons make a good connection for the current, but as the current in *e* has increased by opening the cut-out, the magnets *H H* increase in strength and *F* is drawn more violently upward. This, of course, begins to separate the carbons. In drawing two carbons slowly apart, through which a current of electricity is flowing, a vapor is made by the passing of minute particles of carbon dust from the positive to the negative pole (*B* to *C*), which acts as a fair conductor for the electric current. These particles are heated to an intense white heat, and thus we get the most brilliant artificial light ever produced. By this means we can draw the carbons apart and maintain an electrical connection between the points at a distance entirely impracticable if there was only cold dry air between them. The proper distance for the carbon points to be separated is about ⅛ of an inch. When this distance has been reached the vapor path offers a normal amount of resistance to the passage of the current, and the intensity of the arc has reached its proper point.

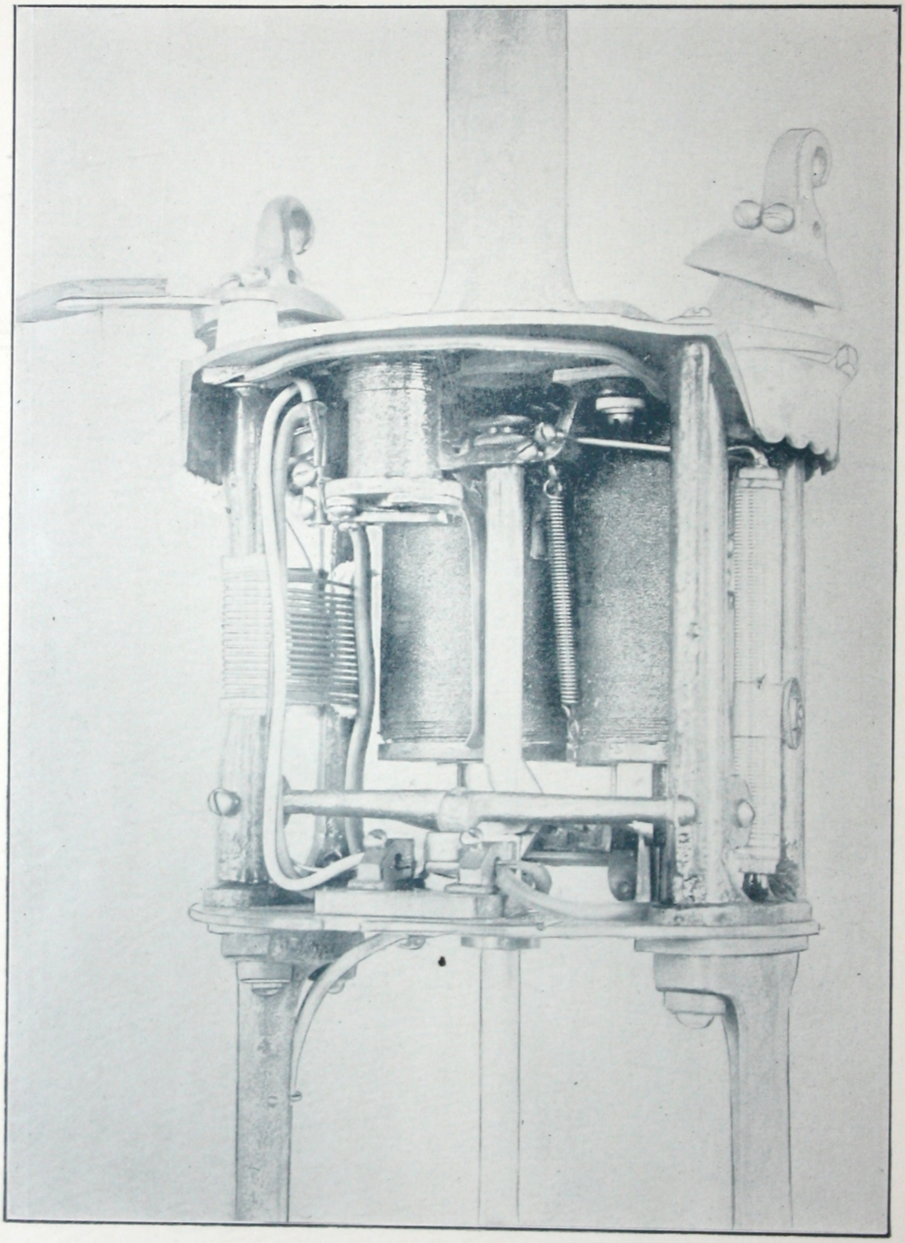
To repeat, then, this beautiful electrical operation, *V* offers just enough resistance to slightly magnetize the spool magnets and start the armature on its upward movement, which in turn opens the cut-out so that more current must pass around said magnets, which in its turn slowly separates the carbon points to their proper distance while the current is passing through them, and thus THE ARC IS ESTABLISHED.

If things would now remain stationary—that is, if the carbons would not burn away—this little work could almost be closed at this point. The fact is, however, that the carbons begin to burn away and, of course, the distance between them widens. This, of course, increases the resistance. Now a peculiar thing happens. Tracing *e* will be found *S*, at which point there is tapped to *e* a fine wire *f*. This fine wire is wound on both spool magnets in such a manner that the current travels in a different direction from that passing through *e*. If two men take hold of the same rope and pull in opposite directions there may be considerable energy expended, but their efforts will tend toward offsetting each other. If their efforts are equal there will be an exact balance. This fine and coarse wire on the same spool magnets, with currents running in opposite directions, has a similar effect. Such an arrangement preserves an electrical balance, and can be arranged to lean toward either side, depending entirely upon the respective lengths and sizes of the two wires. The coarse wire makes a North Pole of the core of one of the spool magnets, while the tendency of the fine wire is to make a South Pole of the same core. Thus, while *e* is trying to lift the armature *F*, *f* is trying to let it fall. As the cross section of *e* is much greater than that of *f*, it will be observed that when the cut-out is closed at the starting of the apparatus scarcely any current passes through *f*. Returning to our rule about two or more paths and proportional resistances, we can see that *f* must receive such a proportion of the current flowing through *e* as its resistance compares with the resistance of *e*. Now, as the carbons burn away, the resistance must necessarily increase, and more current must pass through *f*. When, therefore, the resistance is raised to a certain figure, which may be pre-determined, then, but not until then, sufficient current will have passed through *f* as to have a neutralizing effect on the power of *H H*. Now we have both men hold of the rope, and the harder the later comer pulls the more depressing effect he has on the other fellow. As the carbons continue to separate the resistance becomes still greater, the magnets loose their influence over the armature, which, of course, lowers by gravity, and thus THE ARC IS REGULATED.

The armature continues to lower the upper carbon, which compensates for the amount of carbon being consumed, until a point is reached where the clutch trip strikes an obstruction, as explained in Figure 2. When this occurs the rod is released and allowed to drop. The carbons would now fall together with quite a hard knock if it were not for the fact that, as they approach each other, the resistance is decreased to such an extent that *f* receives a very small proportion of the current, and the neutralizing effect of the magnets *H H* is lessened. Thus, in our electrical tug of war, the first man has pulled the other one over and, for a brief time, has won the victory. The armature which, delicately poised, was moving downward as the resistance was increasing, did not go far enough down for the cut-out to operate, as this only occurs when it has dropped its maximum distance. The releasing of the upper carbon (as has just been stated) decreases the resistance enough to detract from the electric current in *f*, and therefore *e* (which, being a heavier wire, carries more current with less resistance) exercises a controlling influence over the armature *F*, which begins to rise as before. Thus the operation is repeated over and over again, our electrical athletes never weary of striving against each other, the victory always being in doubt, and, with no sputtering, hissing or flashing, a brilliant light is maintained between the carbon points, and thus THE CARBONS ARE FED.



New Brush Lamp.
From Photograph.



New Brush Lamp.

From Photograph.

THERE are three principal kinds of regulating mechanisms to arc lamps :

1. Electrical differential, having coarse and fine wire on same spools.
2. Mechanical differential, " " " " " separate spools.
3. Shunt, the fine wire acting against spring or weight.

Each kind, however, employs necessarily two opposing forces for influencing the arc. A well known form of lamp employs a coil spring for the prime force to work against, and a balance established by a mechanical device on one side, with an electrical device on the other, must be decidedly inferior to the electrical balance. The variableness of the mechanical side is immovable as far as the electrical circuit is concerned. In the case where one side of the balance is mechanical, our first man is pulling on the rope, but the other end is fastened to a post or flexible sapling, and, although a certain balance is maintained, it is a dead balance. The flexible feature about the Electrical Differential Lamp is a very important one for central stations. It often happens that it is desirable to run a few more lamps on a circuit, for a short time, than the capacity of the dynamo would warrant. It is sometimes absolutely necessary to do so. If, when running a 50-light machine, it so happens that it is necessary to run 70 for a brief period, it can be done only by cutting down the candle power of all the lamps. This is accomplished, of course, at the expense of the brilliancy of the light, but in some emergencies this is of secondary importance. As an instance of this fact a recent fire destroyed all of the Brush dynamos in a large station except one No. 8, 65-light machine. They were fortunate enough to have Brush lamps, and ran 112 lamps on the one dynamo for three nights, until other dynamos could be procured, thereby complying with an ironclad agreement with the city authorities, and saving a large amount of money. This would have been impracticable with the shunt feed lamp, as the carbons would have fed the same, regardless of the current passing through the main circuit, the lamps would have demanded their normal number of volts, and the dynamo would have worked very imperfectly and most likely broken down.

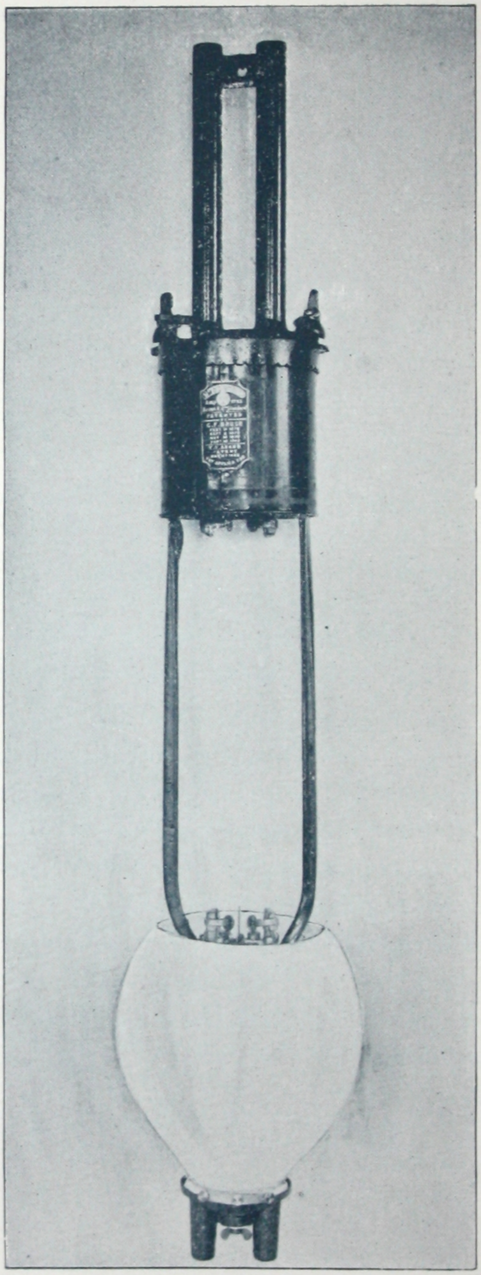
The new Brush electrical differential feed lamp herein described, balances the carbons so nicely that at fifty volts pressure the armature is moving upwards separating the carbons, while at fifty-one volts pressure the armature is moving downward carrying the carbons together again. All of the lamps are tested and guaranteed to regulate within three volts.

Let us now examine another feature of the lamp. All kinds of accidents, and even stupidity in employes, must be provided for.

By following *f* we find that it is wound around a small spool *K* at the top of the lamp called an auxiliary cut-out spool. We see also that *f* is fastened to a metal plate *Y* on the bottom of *K*, against which it is possible for the armature Y^1 to strike and make a connection. The fact that *f* is a small wire with considerable resistance must not be lost sight of. *g* is a larger wire which is also attached to *Y* and runs back with only a few turns on *K* to the cut-out post *R*. In order to get at the reason for this apparently unnecessary device let us suppose that, with the lamp burning, a boy throws a stone through the lamp globe and breaks the carbons off. This of course will shut off all possibility of the current passing down *A*, and consequently there is no path for the current except through *e*, then through *f*. Now as the main path through the lamp is taken away by the breaking of the carbons an amount of current will pass through *f* as to endanger the insulation if not the wire itself. *f* being a very small wire a few amperes of current will melt it. Of course the armature *F* starts to fall as soon as the carbons are broken, but electrical action is so much quicker than mechanical action, that a reversal of polarity is caused in *H H* which re-attracts and holds up the armature *F*, and the magnet spools would be destroyed unless prevented. Of course, as soon as the armature *F* does fall, the cut-out operates and we have our original path for the current re-established—*a*, *b*, *c*, *d*. Until the cut-out, however, has a chance to operate we must save our magnet spools. The auxiliary cut-out spool *K* is, therefore, so arranged that when any flood of current flows into the fine wire *f* the armature Y^1 is attracted to *Y* by the magnetization of *K*. As soon as Y^1 touches *Y* the current takes the following course: *b*, Y^1, *Y*, *g*, *R*, *d*. Study this point. It is a beautiful illustration of the flexibility of the electric current in general and the Brush lamp in particular. Still we are not through. When Y^1 touches *Y* the main magnet spools are thereby entirely short-circuited, the electric current taking the path just described. If up to this point the armature *F* has been held up against the spool magnets by the current passing through *f* it must now surely fall, as the path *b*, Y^1, *Y*, *g*, *R*, *d* cuts them out of circuit altogether. As sure as *F* falls the cut-out works, *J* making the connection between the cut-out posts *T* and *R*. This cut-out always works, and will as long as the law of gravitation lasts. Its falling into action is not dependent upon any resistance or spring, and no adjustment to it is necessary. Now, as soon as the cut-out is closed, the current forsakes the path just described and takes the path *a*, *b*, *c*, *d*. It does this for the reason that the path *a*, *b*, *c*, *d* is a much easier one than the former. Then, when the path *a*, *b*, *c*, *d* is established, there is so little current passing around the auxiliary spool *K* that the armature Y^1 drops away from *Y*. In this manner the auxiliary cut-out spool comes into use when occasion demands and cuts out the main spool magnets, while the cut-out then comes into use cutting out the auxiliary spool cut-out.

Thus we get our original path again, and as soon as the lamp is retrimmed it will start up of its own accord and perform all the operations herein described noiselessly and perfectly in every detail.

i, *j* and *k* is a shunt path from the main circuit that feeds into the carbons through *X* and *W*, through an adjustable German silver resistance. By a thumb-nut P^1 this resistance may be varied so that the lamp will burn on a circuit of quite a range of difference in strength. Now, if the thumb-nut P^1 be moved to the top of *j*, more current will travel from the main circuit via *i* and *k*, and less via *a*, *b*, *c*, etc. If the current strength in *e* is lessened the magnets *H H* will be weaker, and the carbons will feed sooner and remain nearer together. Thus the lamp which, in its normal condition, will require fifty volts to run, might, when adjusted in this manner, require considerably less.


PATENTED
C.F. BRUSH

Minor Mention.

A FEW details may be mentioned which are embodied in this lamp, but which are of minor importance.

All the carbon holders are made adjustable, so that they will take either $\frac{7}{16}$, ½ or ⅝ carbons.

The fine wire is connected to the main magnet spools by coil springs, which are very convenient in connecting and disconnecting. *These are not resistances.*

The lamp is easily taken apart and put together without any soldering whatever.

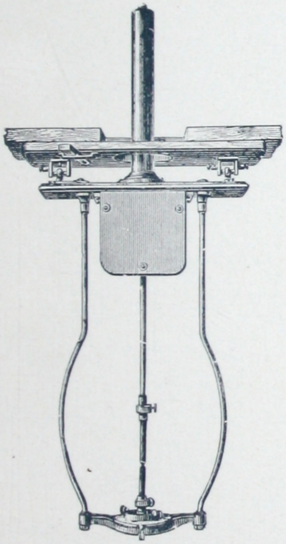
The rods in both the single and double lamps can be easily removed from the lamp while it is hanging in position.

All the parts of both the single and double lamps are, as far as possible, similar—clutches, carbon-holders, hanger-boards, carbon rods, rod-protectors and spark-arresters.

The only tool necessary to change the position of the feeding point to take up the wear on the rod is a screw-driver. This is accomplished by moving the clutch-trip up or down.

On page 22 is shown a new method of dropping the globe for trimming. This is accomplished in two seconds time by simply loosening a thumb nut under the glob-holder. A rod running up the inside between the lower carbon-holders acts as a guide, and an adjustable nut on end of same as a stop. Trimmers will appreciate the saving of time of this device. It is applied only to the double lamps.

The old Brush lamp is so universally used and so well known all over the world that any special description of it is unnecessary. It has occupied the very first position in the history of arc lamps, and all of its salient points and successful features have been embodied and preserved in the new lamp. We still manufacture the old lamps, and are daily supplying them and all parts of same to our customers. The following cuts represent lamps manufactured and kept in stock. Any of the other styles of the old lamp will be made specially if called for.



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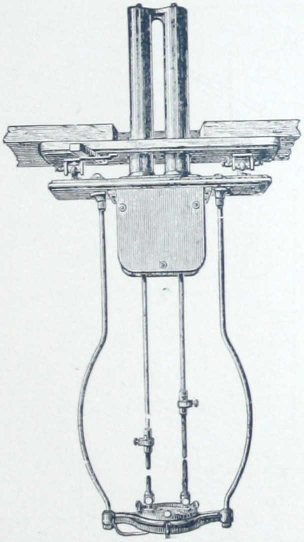
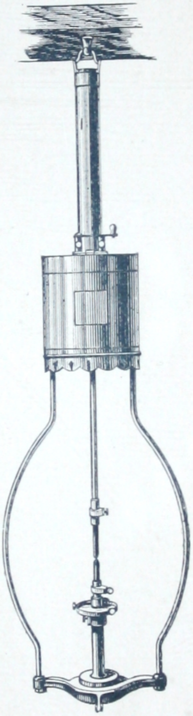


No. 17.



No. 18.

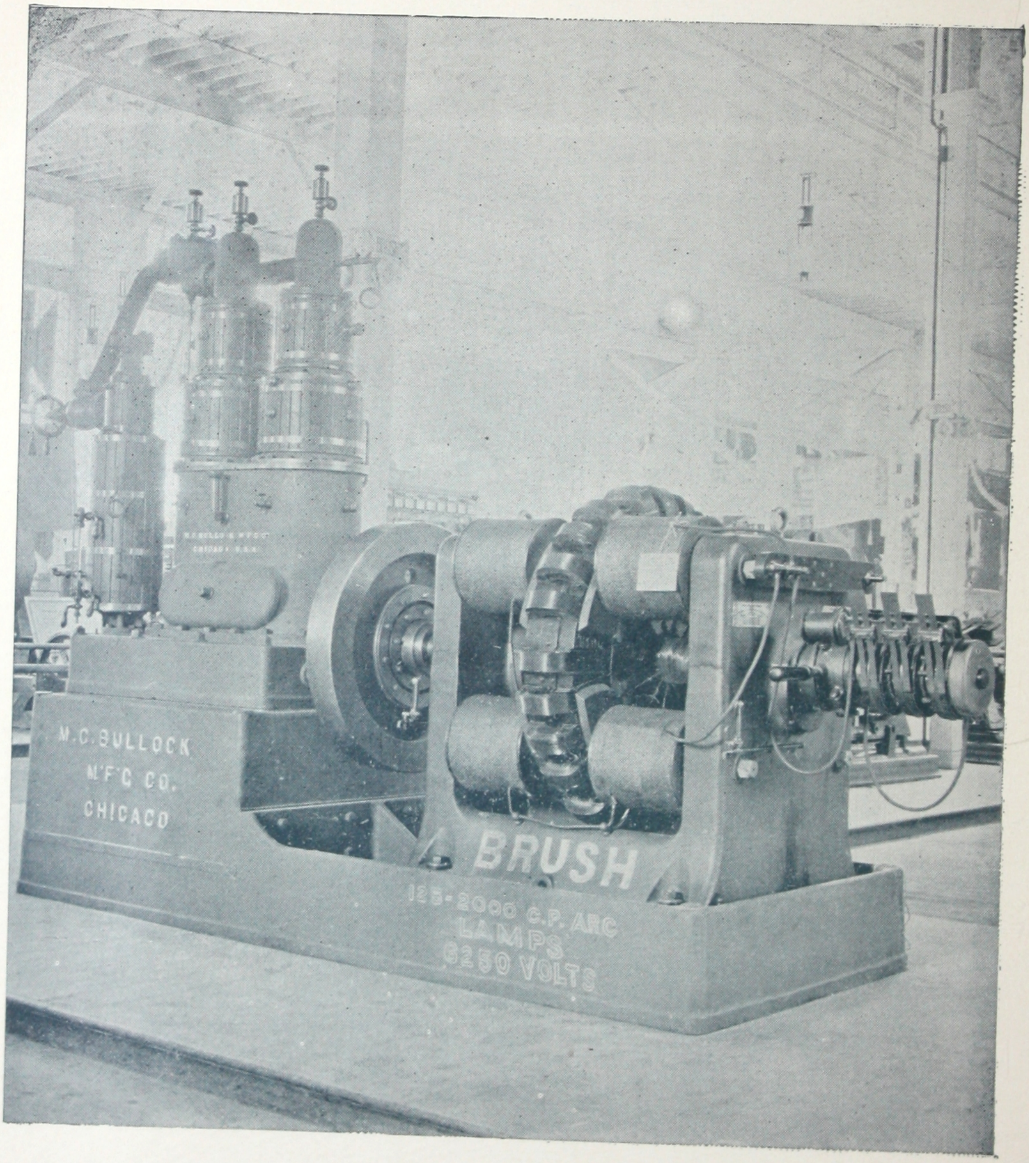
No. 16, Short Rod, Plain Lamp, Single.

No. 17, Short Rod, Plain Lamp, Double.

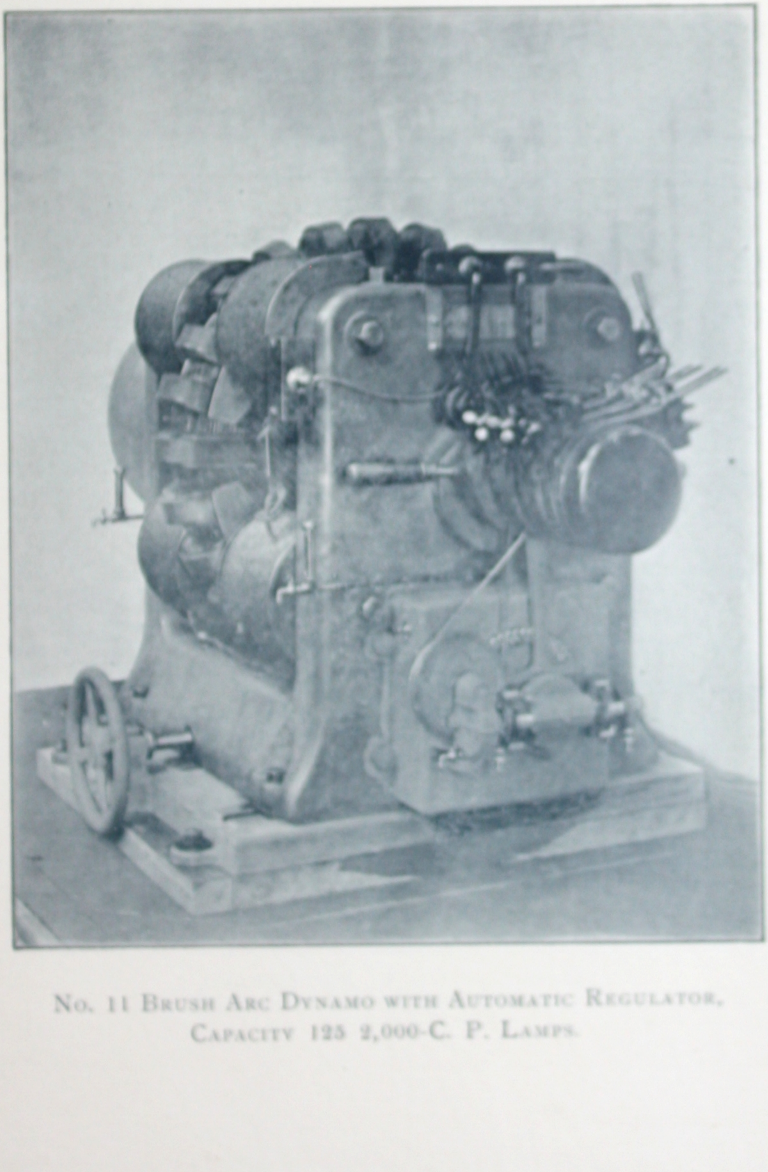
No. 18, Brass Top, Long or Short Rod, Single.

No. 19, Brass Top, Long or Short Rod, Double.

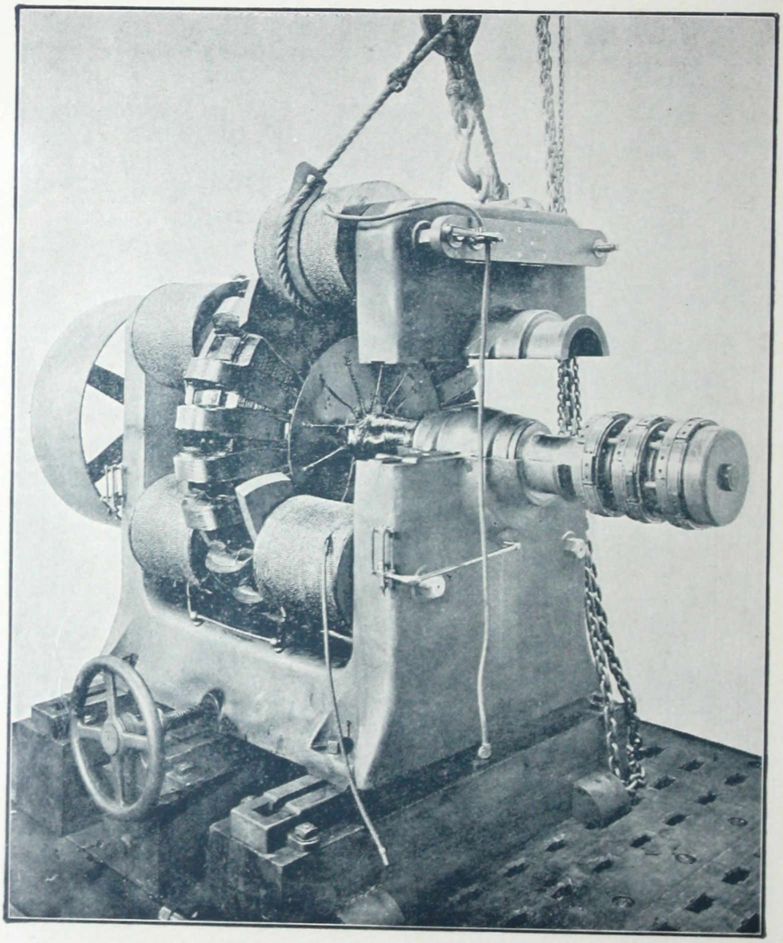
Brush Arc Dynamo.



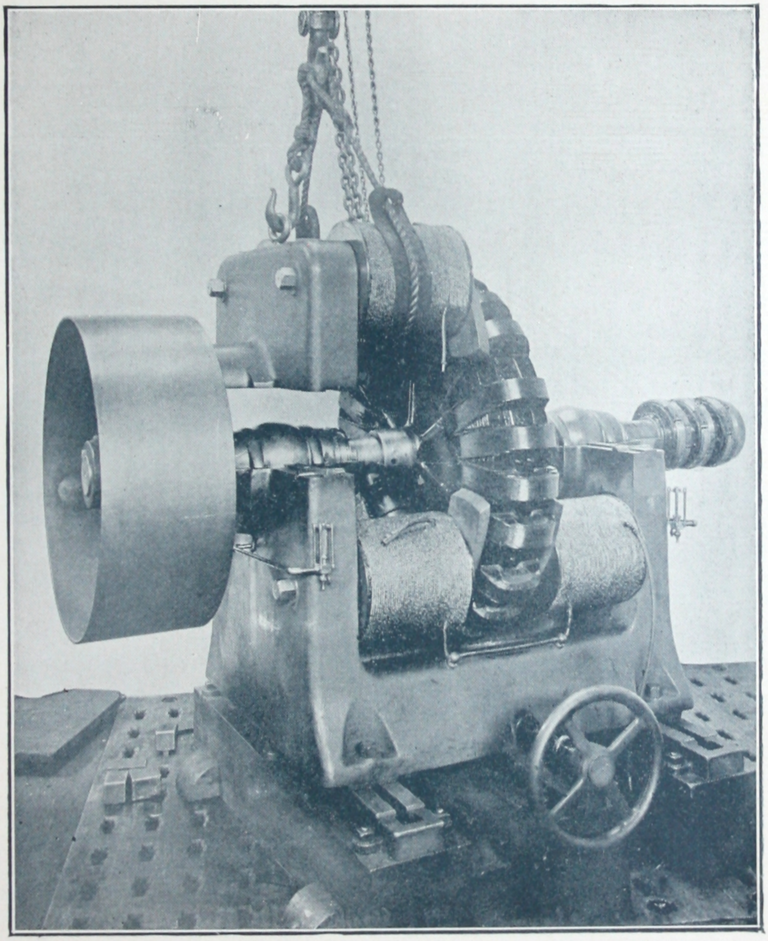
No. 11 Brush Arc Light Dynamo, Coupled Direct to a Willans Vertical Compound Engine.



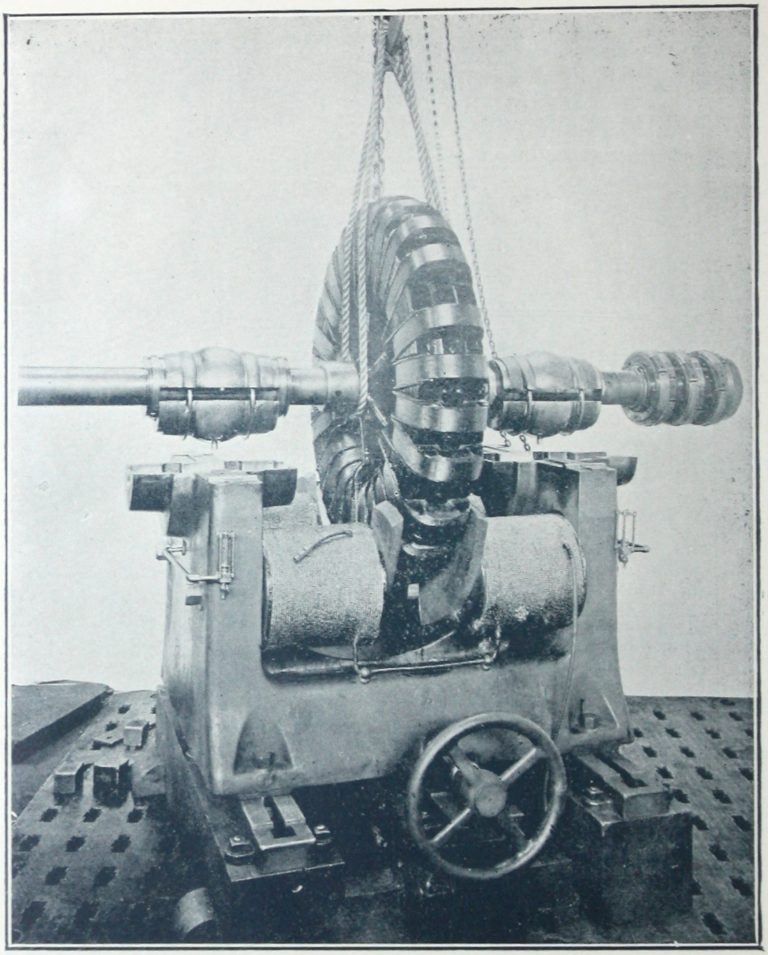
No. 11 Brush Arc Dynamo with Automatic Regulator,
Capacity 125 2,000-C. P. Lamps.



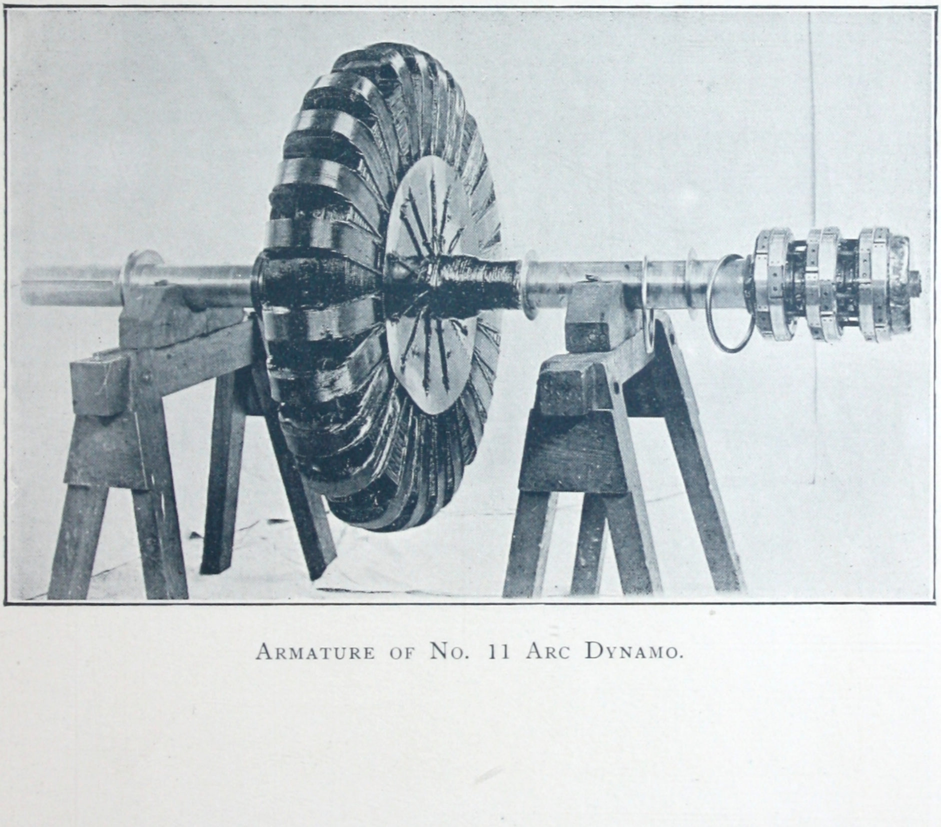
Detail of No. 11 Arc Dynamo.



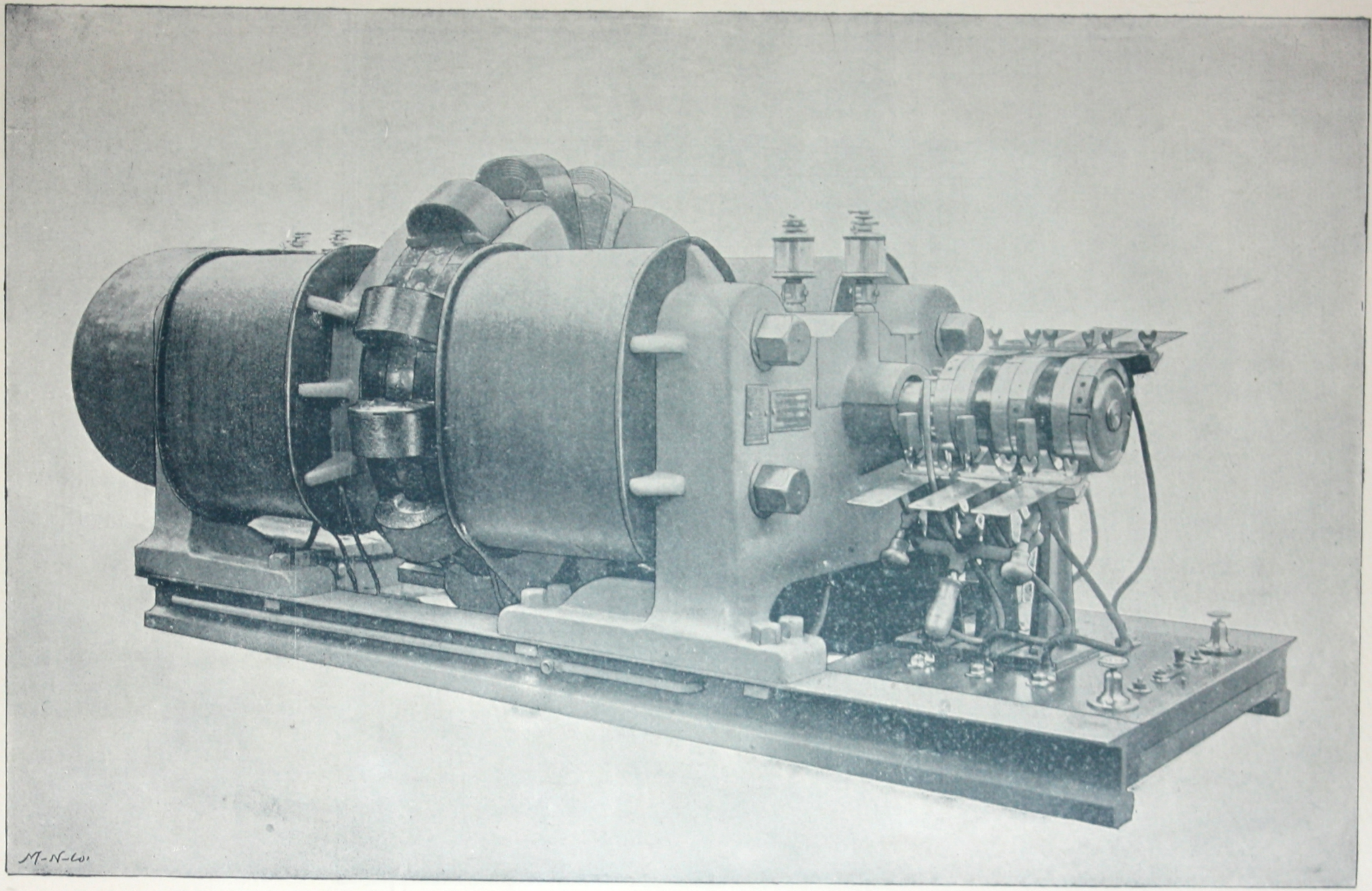
Detail of No. 11 Arc Dynamo.



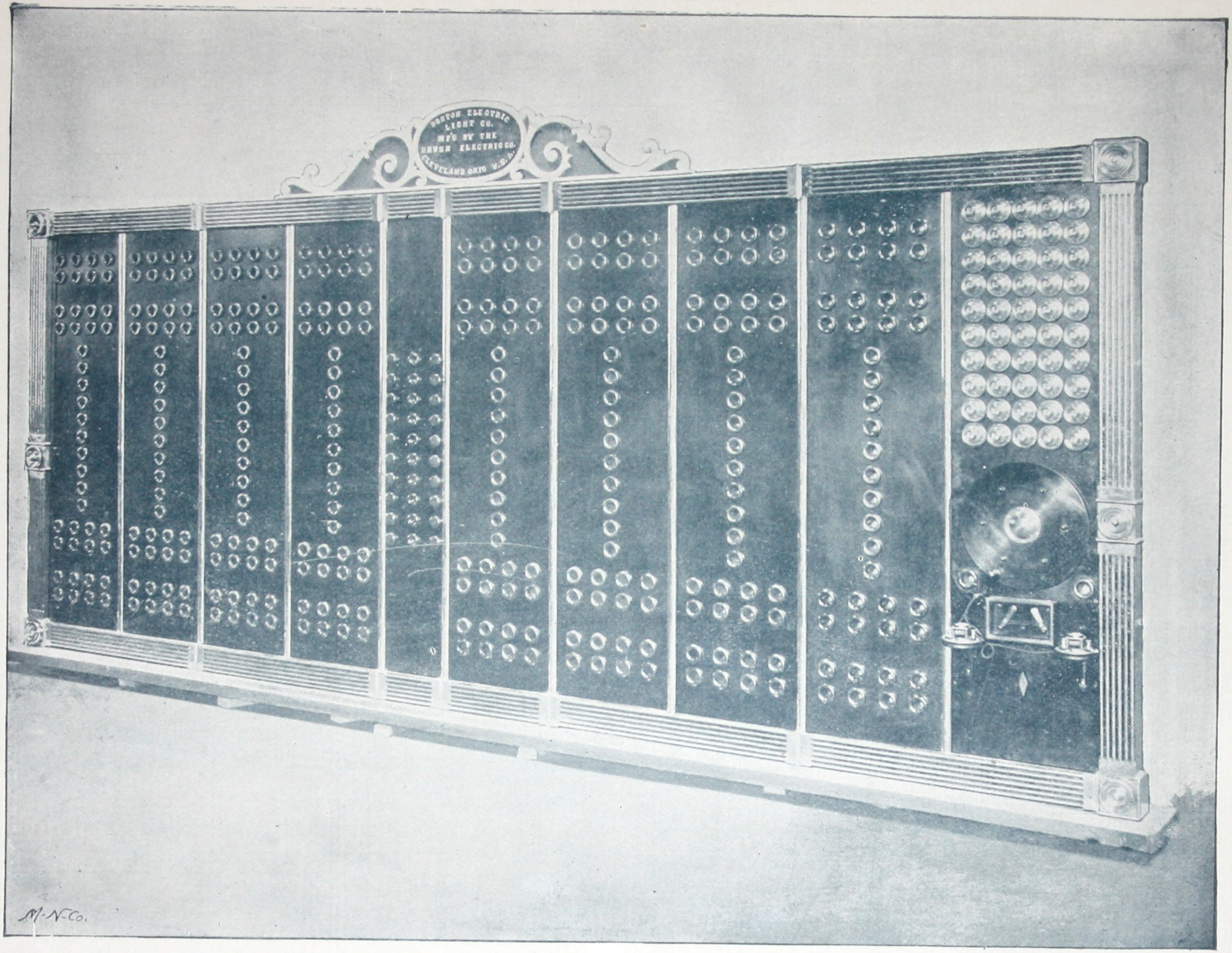
Detail of No. 11 Arc Dynamo.



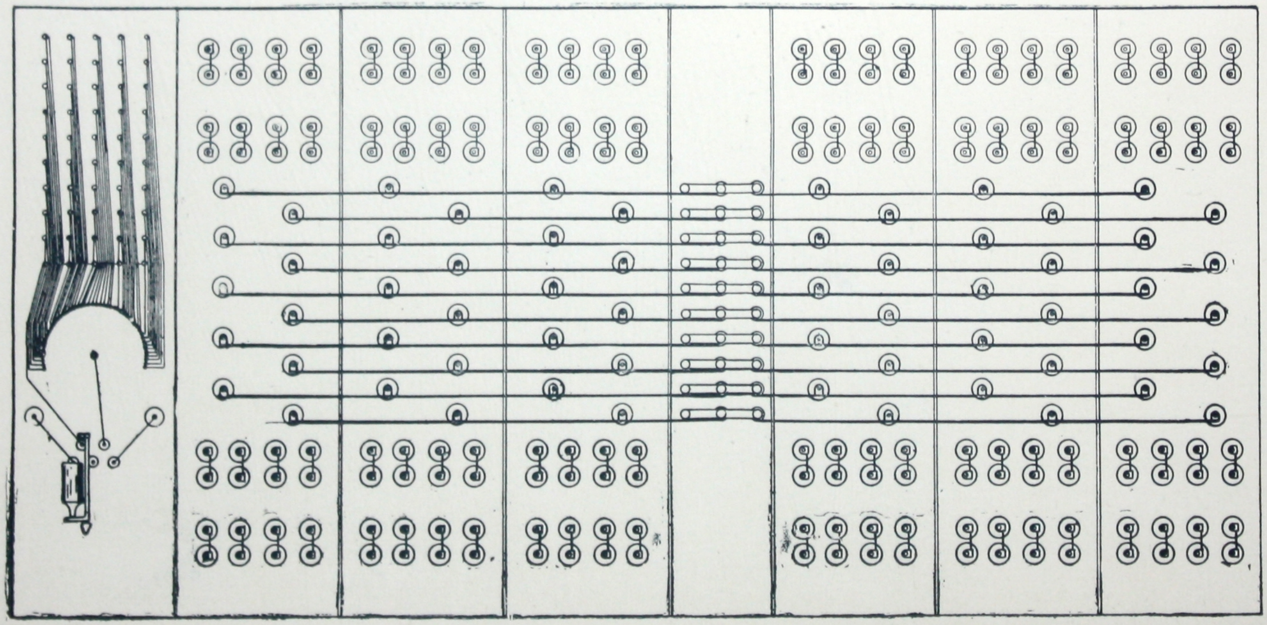
Armature of No. 11 Arc Dynamo.



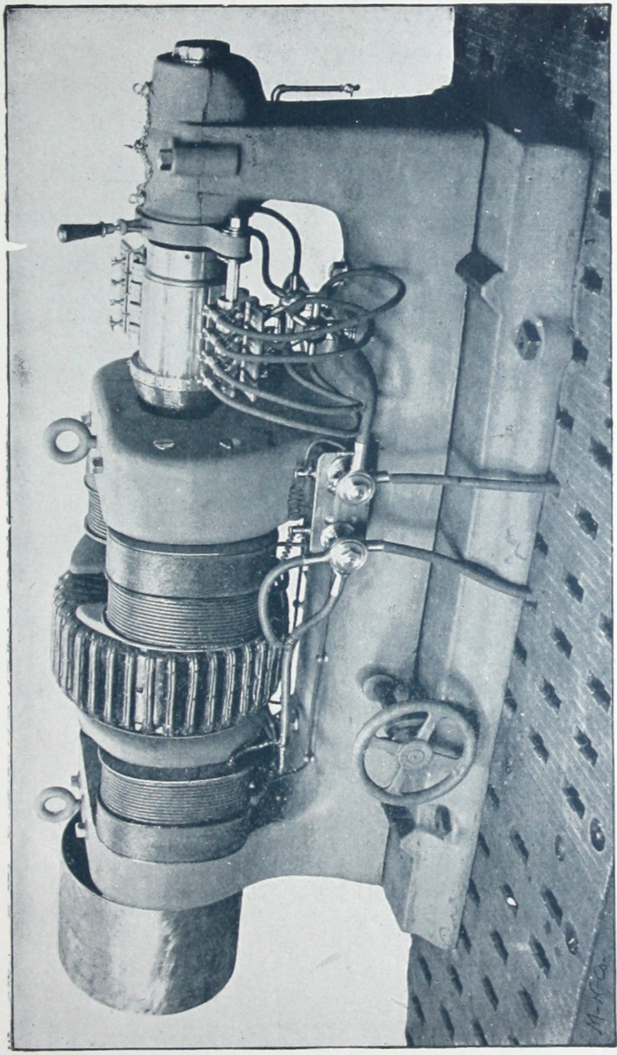
No. 8 Brush Arc Dynamo. Capacity, Sixty-Five 2,000-C. P. Lamps.



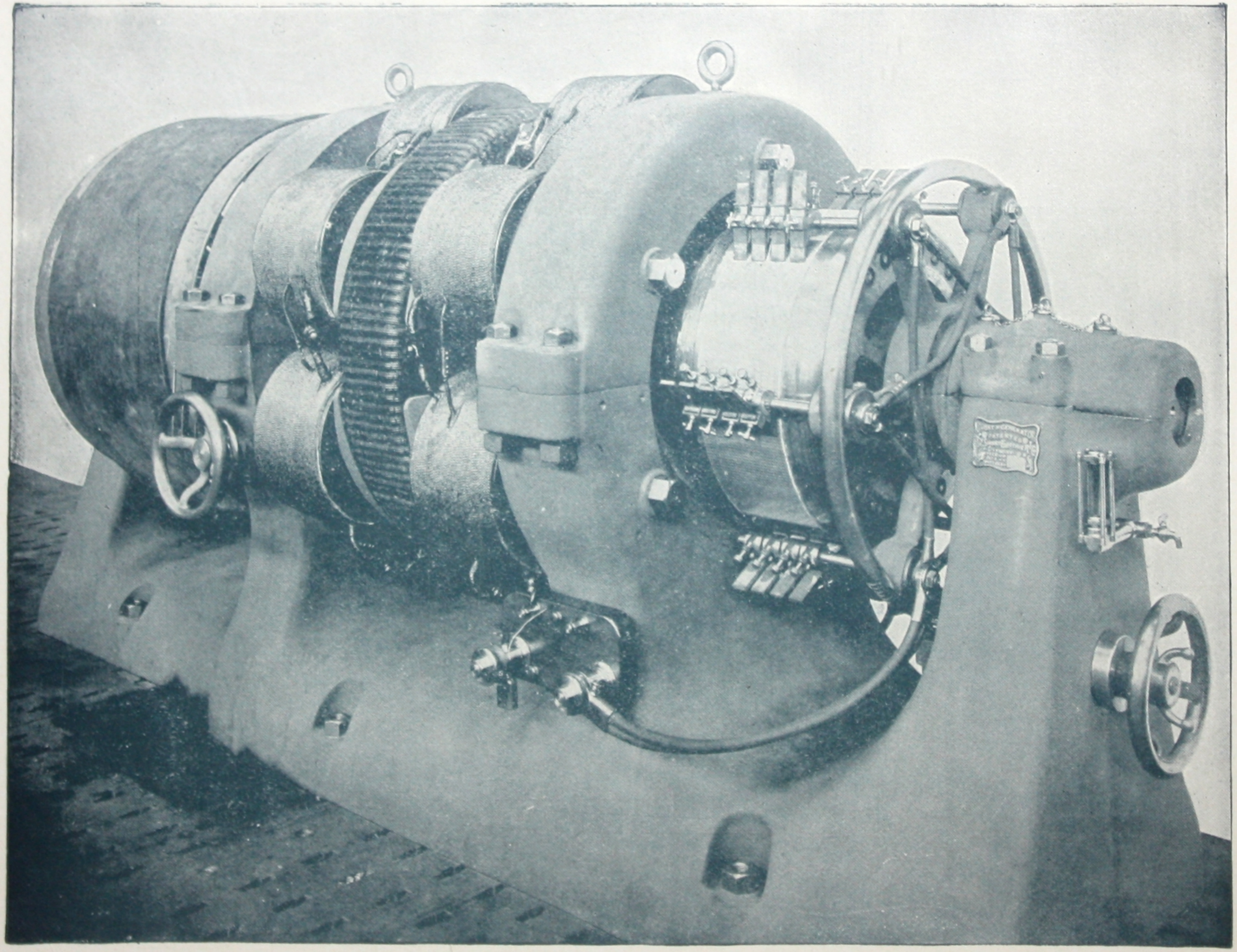
THE BRUSH ARC PANEL SWITCHBOARD, 32 CIRCUIT. NON-COMBUSTIBLE. FRONT VIEW.



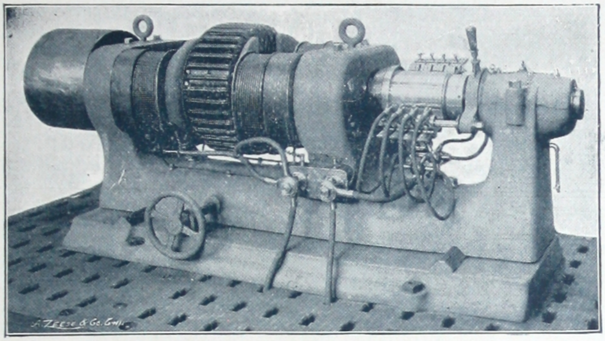
THE BRUSH ARC PANEL SWITCHBOARD, 32 CIRCUIT. SHOWING WIRING AND GROUND DETECTORS. REAR VIEW.



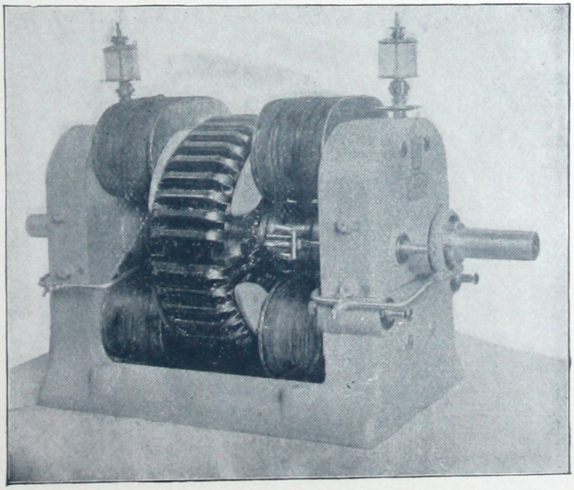
BRUSH INCANDESCENT DIRECT CURRENT MACHINE.



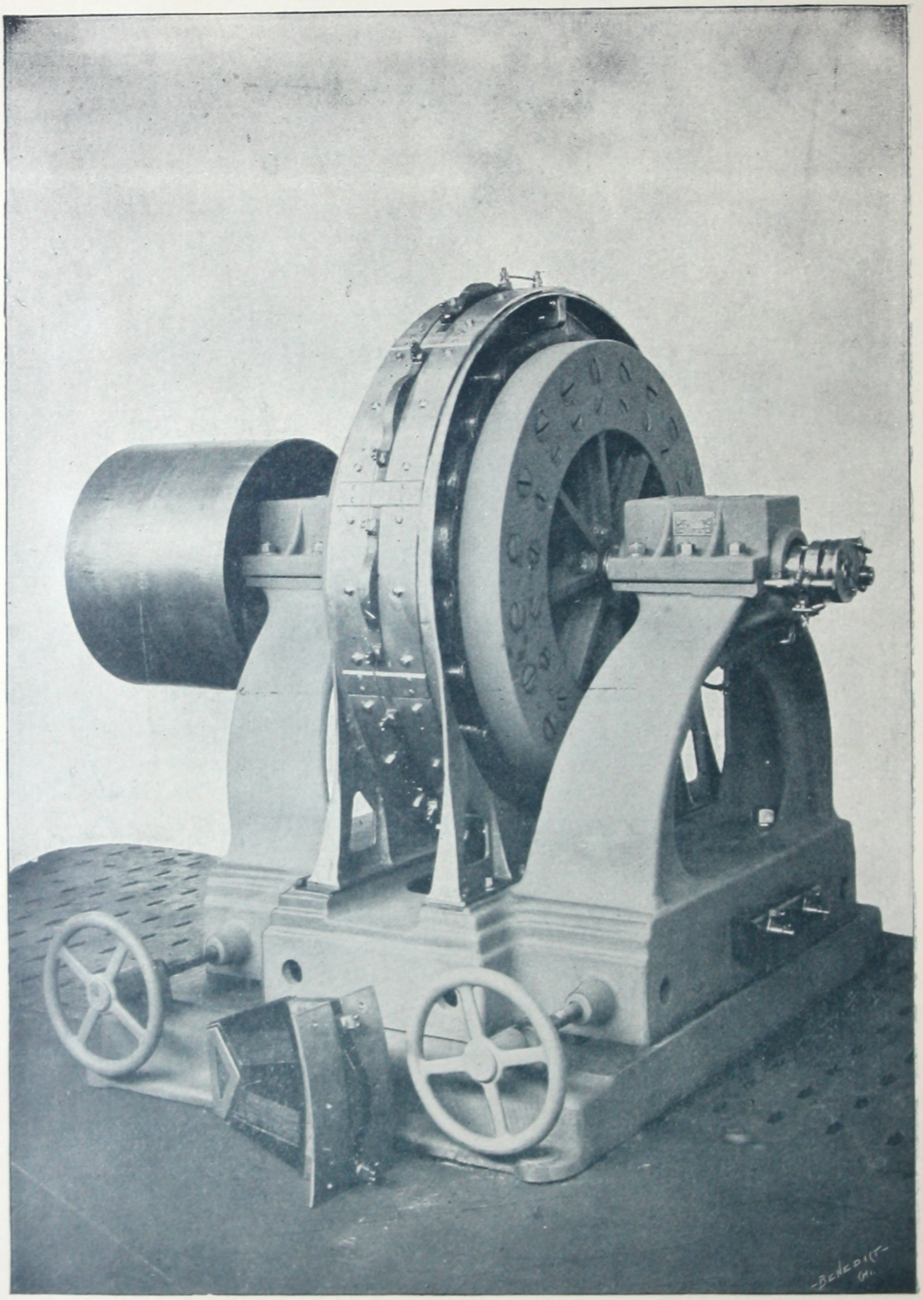
300,000 Watt Brush Generator.



THE BRUSH CONSTANT POTENTIAL MOTOR.
110 TO 1,000 VOLTS.



10 H. P. SLOW SPEED BRUSH MOTOR.



Brush Alternating Dynamo, Capacity 3,000 16-C. P. Lamps.

Two Important Facts.

1· The BRUSH patent on double carbon lamps sustained by 15 Injunctions.

2· Every double carbon arc lamp at Columbian Exposition, Chicago 1893, a BRUSH.